

(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開平9-119983

(43) 公開日 平成9年(1997)5月6日

(51) Int. CL ⁴	識別記号	片内整理番号	P I	技術表示箇所
G 0 1 S 13/93			G 0 1 S 13/93	P
B 6 4 F 1/36			B 6 4 F 1/36	
G 0 1 S 13/75		9419-2E	G 0 8 B 13/24	
13/76			G 0 8 G 5/04	A
13/79			G 0 1 S 13/80	

審査請求 有 請求項の数17 O L (全 6 頁) 最終頁に続く

(21) 出願番号 特願平8-132191

(22) 出願日 平成8年(1996)5月27日

(31) 優先権主張番号 4 5 1 5 9 7

(32) 優先日 1995年5月26日

(33) 優先権主張国 米国 (U S)

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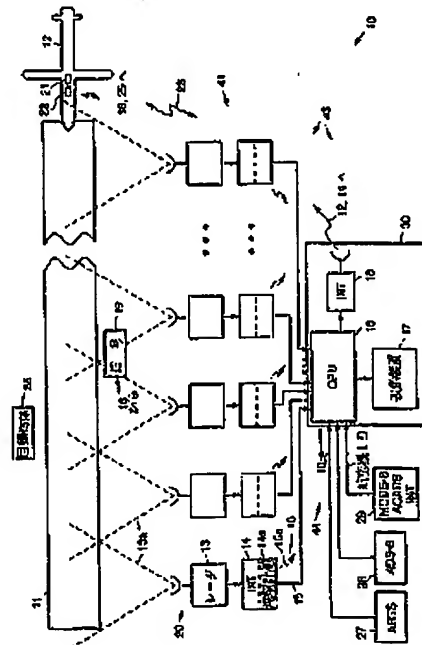
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(54) 【発明の名称】 空港表面監視および滑走路侵入警報システム

(57) 【要約】

【課題】 本発明は、空港における滑走路侵入を監視する現用のASDE-3レーダシステムに比較して廉価で確実に監視することのできる良されたレーダシステムを提供することを目的とする。

【解決手段】 滑走路11に近接して配置され、オーバーラップして滑走路全体をカバーするレーダビーム13aを発生する複数のレーダセンサ装置13を具備するレーダシステム20と、それら各レーダセンサ装置13からのレーダデータを受信して処理し、その付近の目標物体および航空機を識別する滑走路マップを生成する中央処理装置15と、中央処理装置15に結合されてそのマップを表示するオペレータ用表示装置17とを具備していることを特徴とする。レーダセンサ装置13はそのレーダデータを処理するインターフェイスプロセッサ14に結合され、RF遠隔計測電子装置14aによりデータを中央処理装置に送信する。



PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-119983

(43)Date of publication of application : 06.05.1997

(51)Int.Cl.

G01S 13/93

B64F 1/36

G01S 13/75

G01S 13/76

G01S 13/79

G08B 13/24

G08G 5/04

(21)Application number : 08-132191

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(22)Date of filing : 27.05.1996

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(30)Priority

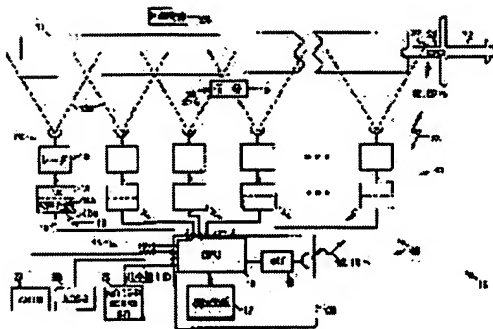
Priority number : 95 451597 Priority date : 26.05.1995 Priority country : US

(54) SURFACE MONITORING AND RUNWAY INVASION ALARM SYSTEM FOR AIRPORT

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an improved radar system for monitoring the runway invasion in an airport surely and more inexpensively than a current airport surface detection equipment(ASDE-3) system.

SOLUTION: The inventive system comprises a radar system 20 including a plurality of radar sensors 13 arranged closely to a runway 11 and generating radar beams 13a for covering the entire runway while overlapping, a central processing unit 16 for receiving radar data from each radar sensor 13 and processing the radar data to generated a runway map for discriminating nearby targets and aircrafts, and an operator display 17 for displaying the map connected with the central processing unit 16. The radar sensor 13 is connected with an interface processor 14 for processing the radar data and delivers a data to the central processing unit through an RF remote measuring electronic unit 14a.



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3. In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the radar system used in order to perform the surface monitor and RWY invasion alarm for a radar system, especially airports.

[0002]

[Description of the Prior Art] Inhibition of RWY invasion is a problem which the interest is increasing, and airport surface detection equipment (ASDE-3), the airport movement area system (AMASS), and the airport surface traffic automation program (ASTA) are developed. this invention -- and the column where the conventional system related to the surface monitor for airports and a RWY invasion alarm system is ASDE-3 radar system most, and it adjoined the airport -- it is the real aperture radar of single Ku band of high power arranged upwards. ASDE-3 radar system tends to receive the part and multiple echo which become the shade which has serious effect for the engine performance. ASDE-3 radar system does not have the capacity asked to the movement object and aircraft of the automatic soft sugar currently supervised by the system. Moreover, ASDE-3 radar system is comparatively expensive.

[0003]

[Problem(s) to be Solved by the Invention] Therefore, the purpose of this invention is offering the improved radar system which surpasses ASDE-3 radar system which can be used in order to

supervise the front face and RWY invasion in an airport, and which is used now.

[0004]

[Means for Solving the Problem] The above-mentioned purpose is attained by the RWY invasion alarm system of the airport of this invention. This invention supervises the RWY of an airport and relates to the RWY invasion alarm system which displays the data in which invasion on the RWY which is not recognized by the operator is shown. A radar system possesses two or more radar sensor equipments arranged in the installation location close to the RWY where the airport was chosen defined beforehand, and each radar sensor equipment relevant to a specific RWY generates the radar beam which the RWY is irradiated, and the adjoining radar beam overlaps it typically, and covers a RWY completely. Each radar sensor equipment is combined with the interface processor and telemetering electronic instrument which perform the interface between each radar sensor equipment and a central processing unit and which were assigned. electrical connection with the physical communication link between each radar sensor equipment and a central processing unit -- and -- or it is carried out by RF communication link which uses a telemetering electronic instrument. Physical electrical connection can be performed by the communication link to the existing cable and each radar sensor equipment which usually supply power to the floodlight equipment of a RWY.

[0005] It is combined with the indicating equipment for operators, and a central processing unit processes the data obtained from each radar sensor equipment, and displays the data. It is used in order to communicate with the aircraft which the central processing unit was combined with RF telemetering interface, and this RF telemetering interface communicated with radar sensor equipment, and is equipped with electronic tag equipment or a transponder system. A central processing unit is displayed combining the data which were combined, for example, were supplied to it from alien systems, such as ARST, ASDE-3, MODE-S, or an ACARS system, again. A central processing unit generates the display which shows the RWY of an airport with the movement target body and quiescence target body which exist near a RWY again. A start and the arrival aircraft, a building, the automobile near a RWY, etc. are included in such a target body. Therefore, this invention offers the perfect display of a runway environment to an operator.

[0006] The system of this invention can be used to the movement object of the aircraft and others which have the target body which does not carry out joint actuation, a movement object,

electronic tag equipment, or RF transponder (transmitter and receiver) system. the identification information concerning [electronic tag equipment or RF transponder] the movement object or target body of the aircraft and others -- containing -- **** -- a question signal -- receiving -- the question signal -- answering -- identification information -- and if it is, the additional information on other will be transmitted.

[0007] The interface processor corresponding to each radar sensor equipment, a telemetering electronic instrument, and RF telemetering interface offer the communication link between radar sensor equipment and a central processing unit. RF telemetering interface transmits a question signal and receives identification information from the movement object of the aircraft which works together, and others. Instead, identification information is received by the central processing unit of an airport, and on the other hand, RF telemetering interface can also transmit only a question signal so that the existing equipment, for example, MODE-S, or the existing ACARS system of the aircraft may be suited. The question signal of a large number transmitted by different radar sensor equipment is separated and identified based on the time amount of reception of the GPS positional information included in the recognition signal or the recognition signal itself.

[0008] A telemetering electronic instrument receives the data generated by radar sensor equipment, and a central processing unit accumulates the data outputted by radar sensor equipment and the electronic tag equipment of the aircraft, or RF transponder. A central processing unit generates the map of the airport which identifies the aircraft without the target body which processed the identification information obtained from the data and electronic tag equipment which were outputted from radar sensor equipment, and was recognized, and fear of invasion, and the invading target body. The display for operators displays the map generated by the central processing unit.

[0009] A central processing unit answers invasion detected by the system, and generates an alarm signal, and the alarm signal is transmitted to the aircraft by RF telemetering interface and RF transponder. A central processing unit generates the image of the identification information about the asked aircraft which was obtained from the image and the electronic tag equipment, or RF transponder of a RWY which identifies a target body and the aircraft from which a RWY lands and takes off. A central processing unit generates the data for a display including the display which shows landing of the list of the priority alarm information, the arrival, and the start

aircrafts in which the aircraft which may trespass upon a RWY again is shown, arrival, and the start aircraft, and a takeoff pattern.

[0010] Therefore, the system of this invention offers the system which has been arranged by approaching a RWY and by which the radar of low cost was distributed comparatively. Each radar covers the limited include-angle range, and the whole system covers the whole RWY area of an airport. The system of this invention gives the point of the asked aircraft which uses electronic tag equipment or a transponder system for the surface map of movement objects, such as an aircraft and an automobile, and discernment.

[0011] The RWY invasion alarm system of this invention is low cost remarkably as compared with ASDE-3 radar system, and is not influenced of the multiple echo which poses a problem with ASDE-3 radar system. The system of this invention can change a scale easily so that it can be used for the monitor of the airport of various scales. This system has high distance resolution and rate information, and it can use them in order to question the electronic tag equipment or RF transponder arranged on a movement object and the aircraft in order to give identification information to the aircraft traffic control equipment which operates a system. The system of this invention can offer the surface monitor of an airport, and the real-time display of a RWY invasion alarm.

[0012] Various descriptions and advantages of this invention will become still clearer by detailed explanation of the following which referred to the accompanying drawing.

[0013]

[Embodiment of the Invention] Reference of a drawing shows the block diagram of the RWY invasion alarm system 10 by the principle of this invention to drawing 1 . This system 10 is equipped with a radar system 20, and this radar system 20 possesses two or more millimeter wave radar sensor equipments 13 arranged in the installation location of the ground contiguous to RWY 11 of an airport defined beforehand. Each radar sensor equipment 13 is radar beam 13a which it is connected with specific RWY 11, radar beam 13a is generated, and it adjoins typically. It overlaps and RWY 11 is covered completely. However, this is not the need absolutely. Each radar sensor equipment 13 is the interface processor (INT) 14 and telemetering electronic instrument (TELEM) 14a. It is this telemetering electronic instrument 14a unitedly. For example, it communicates with the central-process pin center, large 30 arranged in the control tower of an airport. Intelligent processing is performed in the interface processor 14 in each

installation location, the data rate of the data in which remote transmission is carried out by it is decreased, and a reliability trial is performed. The existing cable 15 for the floodlight equipments of the airport for supplying power and two or more radar sensor equipments 13, the interface processor 14, and telemetering electronic instrument 14a The communication link to each is prepared. Instead, RF communication link of dedication may be prepared.

[0014] A central processing unit (CPU) 16 maintains the map of the target body 26 recognized by accumulating the data received from two or more radar sensor equipments 13, for example, a fixed target without fear of RWY invasion, and a building. A central processing unit 16 can also use the discernment report which collected input data from the ARTS system 27 and ASDE-3 system 28 again, and was obtained. The ARTS system 27 or ASDE-3 system 28 offers the information about the aircraft close to an airport. If ASDE-3 radar system 28 is used, the obtained data will be clear to an aircraft control unit, and will be given to it with a graphic gestalt with an easy translation while being accumulated by the central processing unit 16 and displaying a dynamic real-time status display with a display 17. The sample image of the video presentation equipment 17 given to the operator of a system 10 is shown in drawing 2.

[0015] The aircraft 12 is equipped with an electronic tag like MODE-S or the ACARS transponder system 21 or the question system 21, and RF transponder system 22, and an electronic tag or the question system 21 gives the identification information about the aircraft. An alarm signal is transmitted to the aircraft 12 using the RF communication link 23 by RF / telemetering interface 18, and RF transponder system 22. An alarm signal may be shown in the aircraft arrived and left for RWY 11 again using a terrestrial signalling device 19 like the luminescence LGT arranged by approaching, or a beacon. Furthermore, electronic tag equipment or the question system 21 can also be asked by the system 10 using RF / telemetering interface 18, and RF transponder system 22. A question signal is transmitted to the aircraft 12 using the RF communication link 23, the electronic tag or the question system 21 on the aircraft 12 answers it by outputting the information memorized there, and it is returned to a central processing unit 16 by the RF communication link 23.

[0016] As shown in drawing 1, the system 10 consists of five main subsystems 41-45. The 1st main subsystem 41 consists of service radar systems 20 in two or more radar sensor equipment 13 and electronic instruments which have been arranged in each installation location. The 2nd main subsystem 42 consists of interface processors 14 which are arranged in the location distant

from each radar sensor equipment 13, and are combined with it. The 3rd main subsystem 43 is telemetering electronic instrument 14a arranged in the installation location. And it consists of telemetering subsystems including RF / telemetering interface 18 combined with the central processing unit 16 of the central-process pin center, large 30. The 4th main subsystem 44 consists of central processing units 16, and the 5th main subsystem 45 consists of displays 17 for operators containing a usual display and a usual control terminal. Each main subsystems 41-45 used by this invention are known well, and those connection and actuation are known well by this contractor.

[0017] The display 17 for operators used with the RWY invasion alarm system 10 of this invention displays the information for being used by an airport planner or the aircraft traffic control person. The data given to the indicating equipment 17 for operators make the optimal the data which can be used, and, moreover, make physical contact over a system 10 min. Drawing 2 shows the typical video image displayed on the indicating equipment 17 for operators by the RWY invasion alarm system 10. If drawing 2 is referred to, a display 17 shows the image of RWY 11 of an airport, the location of the aircraft 12 which takes off from the location and RWY 11 of the target body with which the building 26 grade is standing it still and which reaches and lands is identified, and the data 47 from the transponder 21 of the asked aircraft 12 are also contained. The data 47 from each transponder 21 show typically an aircraft number or a flight number as shown with delimiters, such as an alphanumeric, in the frame shown in the display 17. Additional data may be displayed and the display 54 grade which give the real time image which show landing and a takeoff of the list 53 of the priority alarm information 52, the arrival, and the start aircrafts in which the target body or the aircraft 12 determined that they be the information shown in the system area 51 which offer the appropriate system parameter of the data about an instrument landing system (ILS), and time amount and others, and RWY invasion be shown, arrival, and the start aircraft be contained in it.

[0018] The trial by the model in which the preliminary concept of the system 10 of this invention is shown was performed in Los Angeles International Airport (LAX) using the equipment of the trial gestalt of the millimeter wave radar (radar sensor equipment 13) developed by these people. It is shown that a test result has the outstanding engine performance which operates as the system 10 of this invention was expected, and surpasses ASDE-3 radar system. In the above, the improved system new [for the surface monitor of an airport and a RWY invasion alarm] was

explained. Although this invention is explained with reference to the specific operation gestalt, they are some of only many of mere instantiation of the operation gestalt which shows application for the principle of this invention. It is clear that much another configurations can carry out easily by this contractor, without deviating from technical within the limits of this invention.

CLAIMS

[Claim(s)]

[Claim 1] In the RWY invasion alarm system of the airport which calls among empty in the location close to the RWY of an airport, and supervises terrestrial traffic The radar system possessing two or more radar sensor equipments which generate the radar beam which is arranged in the installation location close to a RWY defined beforehand, and irradiates a RWY, and which was overlapped substantially, The radar data which were combined with the radar sensor equipment of these plurality, and were generated by the radar sensor equipment of these plurality are received. The central processing unit which processes said radar data so that the RWY map which identifies the target body and aircraft of the neighborhood may be generated, The RWY invasion alarm system of the airport characterized by providing the display for operators which displays the map of the RWY which was combined with the central processing unit and generated by the central processing unit, a target body, and the aircraft.

[Claim 2] It is the system according to claim 1 combined with RF telemetering interface by combining each radar sensor equipment with the interface processor which processes the radar data generated by the radar sensor equipment, and combining each interface processor with RF telemetering electronic instrument for transmitting radar data to a central processing unit in order that a central processing unit may receive the radar data from the radar sensor equipment transmitted by RF telemetering electronic instrument.

[Claim 3] RF transponder which the aircraft receives the question signal which was combined with the electronic tag equipment which memorizes the identification information about that aircraft, and this electronic tag equipment, and was generated by the central processing unit,

answers that question signal, and transmits identification information is provided. The question signal generated by the central processing unit is transmitted to the aircraft with RF telemetering interface. It is the system according to claim 2 by which identification information is received from RF transponder RF telemetering interface, and a central processing unit generates the signal which identifies the aircraft displayed on the display for operators.

[Claim 4] A central processing unit is a system according to claim 2 combined with said two or more radar sensor equipments by RF communication link which performs the communication link with a central processing unit and radar sensor equipment with RF telemetering interface.

[Claim 5] It is the system according to claim 1 which the ARST system furthermore combined with said central processing unit is provided, and a central processing unit processes the data and the discernment report which were outputted from this ARST system, and coalesces in a map and displays them on the display for operators.

[Claim 6] It is the system according to claim 1 which possesses ASDE-3 radar furthermore combined with said central processing unit, coalesces in a map and displays data ** to which the central processing unit was outputted from this ASDE-3 radar on the display for operators.

[Claim 7] A central processing unit is a system according to claim 3 which generates the image of the identification information about the asked aircraft which generated the image of the RWY which identifies a target body and the aircraft which lands and takes off, and was outputted from the transponder.

[Claim 8] A central processing unit is a system according to claim 7 which generates the data for a display including the display which shows landing of the list of the priority alarm information, the arrival, and the start aircrafts in which the aircraft which trespasses upon a RWY is shown, arrival, and the start aircraft, and a takeoff pattern.

[Claim 9] It is the system according to claim 2 by which a central processing unit answers the invasion object detected, and generates an alarm signal, and the alarm signal is transmitted to the

aircraft by RF telemetering interface and RF transponder.

[Claim 10] In the RWY invasion alarm system of the airport which calls among empty in the location close to the RWY of an airport, and supervises terrestrial traffic It is arranged in the installation location close to a RWY defined beforehand, and two or more radar sensor equipments which generate the radar beam which irradiates a RWY, and which was overlapped substantially are provided. Each radar sensor equipment is combined with the interface processor which processes the radar data generated by the radar sensor equipment. The radar system combined with RF telemetering electronic instrument for each interface processor to transmit radar data to a central processing unit, The radar data which were combined with the radar sensor equipment of these plurality, and were generated by the radar sensor equipment of these plurality are received. Said radar data are processed so that the RWY map which identifies the target body and aircraft of the neighborhood may be generated. The central processing unit combined with RF telemetering interface in order to receive the radar data transmitted from radar sensor equipment by RF telemetering electronic instrument, The RWY invasion alarm system of the airport characterized by providing the display for operators which displays the map of the RWY which was combined with the central processing unit and generated by the central processing unit, a target body, and the aircraft.

[Claim 11] RF transponder which the aircraft receives the question signal which was combined with the electronic tag equipment which memorizes the identification information about that aircraft, and this electronic tag equipment, and was generated by the central processing unit, answers that question signal, and transmits identification information is provided. The question signal generated by the central processing unit is transmitted to the aircraft with RF telemetering interface. It is the system according to claim 10 by which identification information is received from RF transponder RF telemetering interface, and a central processing unit generates the signal which identifies the aircraft displayed on the display for operators.

[Claim 12] A central processing unit is a system according to claim 10 combined with said two or more radar sensor equipments by RF communication link which performs the communication

link with a central processing unit and radar sensor equipment with RF telemetering interface.

[Claim 13] It is the system according to claim 10 which the ARST system furthermore combined with said central processing unit is provided, and a central processing unit processes the data and the discernment report which were outputted from this ARST system, and coalesces in a map and displays them on the display for operators.

[Claim 14] It is the system according to claim 10 which possesses ASDE-3 radar furthermore combined with said central processing unit, coalesces in a map and displays the data with which the central processing unit was outputted from this ASDE-3 radar on the display for operators.

[Claim 15] A central processing unit is a system according to claim 11 which generates the image of the identification information about the asked aircraft which generated the image of the RWY which identifies a target body and the aircraft which lands and takes off on a RWY, and was outputted from the transponder.

[Claim 16] A central processing unit is a system according to claim 15 which generates the data for a display including the display which shows landing of the list of the priority alarm information, the arrival, and the start aircrafts in which the aircraft which trespasses upon a RWY is shown, arrival, and the start aircraft, and a takeoff pattern.

[Claim 17] It is the system according to claim 10 with which a central processing unit answers the invasion object detected, and generates an alarm signal, and the alarm signal is transmitted to the aircraft with RF telemetering interface.

